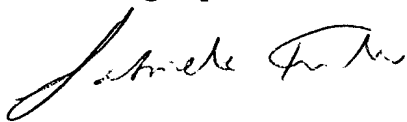


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Verification of Translation
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I, Gabriele Fuchs, residing at Martin-Albert-Str. 4, 90491 Nuremberg, Federal Republic of Germany, hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof. I declare further that, to the best of my knowledge and belief, the forgoing is a true, faithful, complete and accurate translation of PCT/EP2004/013739, filed on December 03, 2004, in the name of Conti Temic microelectronic GmbH the original of which has been submitted to me in the German language.

Nuremberg, April 23, 2006



Gabriele Fuchs

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AUTOMATIC GEARBOX WITH INFINITELY-VARIABLE RATIO

The invention relates to a an automatic gearbox, for a
5 motor vehicle, with infinitely-variable ratio, which may be
operated in a constant speed mode, or an acceleration mode.

Infinitely-variable gearboxes, which are also called CVT-
gearboxes (continuously variable transmission), are based
10 on the principle of belt drives, in which the transmission
ratio between the shortest and longest transmission is
infinitely-variable with the aid of a so-called variator.
An infinitely-variable ratio of this type is best suitable
for an optimum exploitation of the torque produced by the
15 engine. As the ratio is infinitely-variable, an adequate
ratio is always provided for an efficiency-oriented, but
also for a consumption-oriented driving characteristics, in
which the engine can work in the optimum operating range.

20 The variator consists of two pairs of cone pulleys, the
primary set of pulleys and the secondary set of pulleys as
well as of an enlacement means, which for instance can be
formed as a plate link chain and which serves as a force
transmission element. The primary set of pulleys is driven
25 by the engine, the engine torque is transferred via the
chain to the secondary set of pulleys and is guided into
the axle drive. One cone pulley each is moveable on a
shaft, whereby the run diameter of the chain and thus the
ratio is infinitely-variable. The changes of the ratio are
30 made jerk-free and without any interruption of the tractive
force.

An automatic gearbox with the features of the preamble of
claim 1 is described in the article "Multitronic - the new
35 automatic gearbox of Audi" (ATZ Automobile technical
magazine, 2000, edition 7/8 and 9). This CVT-gearbox can be

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operated either in a constant speed mode, or in an acceleration mode. In the constant speed mode depending on the driving situation a fixed desired revolution speed is predetermined, which depends for example on the speed or
5 the inclination.

In the acceleration mode with a constant position of the acceleration pedal the desired revolution speed is continuously increased, the rise of the increase being
10 dependent on the driving situation. The driver can effect infinitely-variable increases or the reduction of the revolution speed, respectively, via the change of the angle of the acceleration pedal. If the gearbox is operated in the acceleration mode, the speed of the driving motor in
15 the speed follow-up is continuously increased in infinitely-variable manner. Although this gearbox has proved itself in practice, it is partially considered to be disadvantageous that the gearbox behaves different in the acceleration mode than conventional stepped automatic
20 transmissions.

It is, therefore, the object of the invention to create a gearbox, which conveys an improved driving experience.

25 With an automatic gearbox of the type mentioned above this object is achieved according to the invention in that the revolution speed in the acceleration mode can be increased or reduced in steps.

30 Different from the conventional gearbox, in which all changes of the revolution speed in the acceleration mode take place in infinitely-variable manner, revolution the speeds according to the invention are predetermined such that a similar impression as with a gearbox in steps is
35 created. If the driver triggers a change of the revolution speed by more or less strongly activating the acceleration

pedal in the acceleration mode, then the transition to the new revolution speed is effected by a leap of the revolution speed, which is effected within a very short time interval. In this way the infinitely-variable
5 automatic gearbox according to the invention reacts like a manually shifted gearbox or an automatic gearbox with regulating steps.

An infinitely-variable increase of the revolution speed in
10 the acceleration mode corresponds to shifting down in a conventional gearbox.

In accordance with a first form of embodiment of the automatic gearbox according to the invention it is provided
15 that during an acceleration phase the rise of the revolution speed is independent from the ratio at least in sections. In this mode of operation there is no constant ratio as is the case for example with a conventional transmission, but there are phases, in which the revolution
20 speed is increased e.g. in infinitely-variable manner, what corresponds to a changing ratio. Aside, also phases can be provided, in which the revolution speed can be increased or reduced in steps. Thereby, it is particularly preferred that during the starting phase of the acceleration mode the
25 revolution speed is brought to a higher revolution speed value in steps, subsequently, the speed can be continuously further increased in infinitely-variable manner. This variant can be called hybrid mode with infinitely-variable increase of the revolution speed.

30

In accordance with a second alternative embodiment of the invention, however, it may also be provided that the revolution speed can be increased during an acceleration mode with an approximate constant ratio. With this variant
35 the impression of an automatic gearbox with fixed gears is created and during acceleration successively several rises

of the revolution speed with a respective constant ratio are passed through, in order to achieve the desired final speed. This variant can be called hybrid mode with fixed gears.

5

With the hybrid mode with fixed gears it can be provided that after an acceleration phase subject to the position of the acceleration pedal a further stepped rise of the revolution speed or a stepped reduction of the revolution
10 speed can be adjusted. In case by the position of the acceleration pedal it is signalized that the driver desires a stronger speed increase, a second volatile increase of the revolution speed can be effected, which corresponds to shifting down, in order to achieve the desired final speed
15 in a shorter time. In the other case, when the driver activates the acceleration pedal less strongly, a volatile reduction of the revolution speed may be effected, which corresponds to shifting up. Subsequently, the desired final speed can be achieved by a further, however reduced,
20 increase of the revolution speed.

With the automatic gearbox according to the invention it is particularly convenient, if the regulating steps for the increase or reduction of the revolution speed are
25 predetermined as a characteristic line or field, if necessary, subject to further values such as the position of the acceleration pedal or the speed. In this manner a regulating step is associated with each driving situation.

30 The automatic gearbox according to the invention can be formed such that in the acceleration mode as far as to achieving the maximum speed five to ten, in particular seven regulating steps are provided. By the multiple volatile reduction of the revolution speed a particularly
35 sportive and dynamic driving impression is created.

It is not necessary that with the increase and reduction of the revolution speed the same regulating steps are passed through, but also separate regulating steps can be determined.

5

With the automatic gearbox according to the invention a minimum or maximum revolution speed can be associated with a regulating step, in which the step-wise change of the revolution speed can be triggered when falling below or
10 exceeding the minimum or maximum revolution speed. It is not necessary that the minimum or maximum revolution speeds of the individual regulating steps comply with each other, they can also vary.

15 A particularly high ease of use can be achieved with the automatic gearbox according to the invention, if the stepped change of the revolution speed can be activated subject to the selected driving program. For instance it may be provided that the stepped change of the revolution
20 speed according to the invention can be activated merely in the driving program S, which means a sportive driving characteristics. In the driving program D, however, the stepped change of the revolution speed cannot be activated and the automatic gearbox behaves like a conventional CVT-
25 gearbox. The appropriate driving program, in which the stepped change of the revolution speed can be activated, can conveniently be selected by activating a transmission selector lever for the individual driving programs.

30 It may, however, also be provided that the stepped change of the revolution speed in the acceleration mode can be activated automatically subject to the driving characteristics. For instance, sportive driving characteristics can be detected with the aid of the
35 longitudinal or lateral acceleration and of further parameters. Therewith it is possible to effect the stepped

change of the revolution speed according to the invention dependent upon the situation, e.g. if an efficiency-oriented, sportive driving characteristics has been recognized.

5

It may also be provided that in case of a conventional automatic gearbox the stepped change of the revolution speed can be upgraded by an update of the software. The software for the gearbox control is stored in a flash
10 memory, which can be reprogrammed in case of need. In this way it is possible to update older automatic gearboxes to the state of the art of the software.

The invention further relates to a motor vehicle, which
15 comprises an automatic gearbox of the described type.

Further advantages and details of the invention will be described taken in conjunction with the figures and an example of embodiment. The figures are schematic drawings,
20 in which

Fig. 1 shows a revolution speed-velocity-diagram of a conventional CVT-automatic gearbox; and

25 Fig. 2 shows a revolution speed-velocity-diagram of a first and a second example of embodiment of the invention.

Fig. 1 shows a revolution speed-velocity diagram of a conventional CVT-automatic gearbox. The driving speed is
30 entered on the horizontal axis, the revolution speed on the vertical axis. Above from the diagram the respective position of the acceleration pedal is shown.

The automatic gearbox built in a motor vehicle with
35 infinitely-variable ratio can be operated in a constant speed mode or in an acceleration mode. In the constant

speed mode 1 the gearbox has a fixed desired revolution speed, which is predetermined subject to the driving situation. If by activating the acceleration pedal a distinct higher performance is required than is necessary
 5 for constant driving, it is changed into the acceleration mode 2. The constant speed mode 1 permits consumption-favorable driving in the stationary operation, in contrast to which the acceleration mode 2 permits spontaneous and dynamic driving.

10

When shifting into the acceleration mode 2 a speed leap 3 is effected, then the increased revolution speed is further increased in infinitely-variable manner. Above from the revolution speed-velocity-diagram the course of the angle
 15 of the acceleration pedal is shown. It can be seen that the revolution speed is increased as long as the driver keeps the acceleration pedal pushed through. As soon as the acceleration pedal is kept constantly, merely only a low infinitely-variable increase of the revolution speed is
 20 effected, whereby the desired revolution speed is asymptotically approached.

If in the further course the driver takes his foot from the acceleration pedal, the revolution speed in section 4 is
 25 lowered in infinitely-variable manner. In the last section of the diagram of the angle of the acceleration pedal, the acceleration pedal is kept constant. Then shifting takes place from the acceleration mode 2 via a revolution speed leap 5 back into the constant speed mode 6.

30

Fig. 2 shows the revolution speed-velocity-diagram of a first and a second example of embodiment of the invention. The diagram of the first example of embodiment is drawn as a dashed line, the diagram of the second example of
 35 embodiment is drawn as a continuous line.

During the transition into the acceleration mode the constant speed mode 1 and the revolution speed leap 3 correspond to those of Fig. 1. Other than the given values a revolution speed increase is made due to an increase of the angle of the acceleration pedal, in addition to the infinitely-variable revolution speed increase 7, via a stepped shift-down 8.

Subsequent to the revolution speed increase 7 a revolution speed leap 8 is made, as the acceleration pedal is continuously pushed through. The volatile revolution speed increase corresponds to the shifting down with a conventional transmission or with a conventional stepped automatic transmission. The driver has the impression that the gearbox shifts to a lower gear and the vehicle has an improved acceleration.

Then an infinitely-variable increase of the revolution speed 9 is made, which proceeds analogue to the course described in Fig. 1. If the acceleration pedal is slowed-down up to a threshold value, the revolution speed is lowered via a step 10 in volatile manner, so that the impression of an up-shifting gearbox is obtained. Then the revolution speed in section 11 is slightly increased. If the acceleration pedal is kept merely constant, the automatic gearbox passes into the constant speed mode 6 via a further revolution speed leap 12.

An example of embodiment of the hybrid mode with fixed gears is shown in Fig. 2 by the continuous line.

Subsequent to the revolution speed leap 3 during the transition from the constant speed mode 1 into the acceleration mode a revolution speed increase 13 is made with a constant ratio. This ratio is adjusted by control of the variator of the automatic gearbox. The ratio must not

necessarily comply with that of a real gearbox, a "virtual" ratio can be recognized in that its extension does not pass through the zero point of the revolution speed-velocity-diagram. This revolution speed increase 13 corresponds to a gear, which is defined by its minimum revolution speed and its maximum revolution speed. After falling below the minimal speed for this gear a revolution speed leap 14 is made, which is felt by the driver like a shifting down. Then the revolution speed is further increased in the next gear 15 up to a maximum value. The subsequent volatile revolution speed reduction 16 is felt like a shifting-up, which is followed by a revolution speed increase 17 in the next gear. The final speed is achieved by several successive shifting and accelerating processes as is the case with a standard transmission or a conventional stepped automatic transmission.

This hybrid mode with fixed gears is activated, if the driving program S is selected. As an alternative it can be activated also in the driving program D, if the longitudinal and/or lateral acceleration of the vehicle exceeds a fixed threshold value. In this acceleration mode particularly sportive driving is possible, what conveys a dynamic driving impression.